

## SUMMER FOOD HABITS OF COYOTES IN CENTRAL WYOMING

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**ABSTRACT.**— Summer food habits of coyotes (*Canis latrans*) were investigated on a 3100-km<sup>2</sup> area in central Wyoming, divided into one deer-use area and five non-deer areas. Analysis of 404 scats (fecal samples) revealed an overall average of 63 percent occurrence of native ungulates, 63 percent leporids, 46 percent rodents, 14 percent livestock, and 11 percent birds. Pronghorn (*Antilocapra americana*) was the ungulate most frequently consumed, occurring in about 87 percent of the scats. Mule deer (*Odocoileus hemionus*) occurred in only 8 percent, and in 5 percent the native ungulate remains were not identifiable beyond order. This large percentage of big game in the diet is apparently unusual, because big game has been of minor importance in most coyote food-habit studies. The high incidence of leporids is consistent with other studies performed in arid intermountain areas. Although cricetines, especially deer mice (*Peromyscus maniculatus*), were trapped consistently in all habitats, months, and trapping areas, they were found in scats at a lower frequency than microtines and sciurids. This suggests a coyote hunting strategy that selected for the latter two groups.

This study was done by the Wyoming Game and Fish Department to determine the summer food habits of coyotes (*Canis latrans*) in central Wyoming. This project was conducted from June through September 1977, and was one aspect of a general study of ecological relationships between mule deer (*Odocoileus hemionus*) and coyotes (Springer and Wenger 1981).

The study area encompassed about 3100 km<sup>2</sup> in central Wyoming. The southwest corner was about 26 km north of Rawlins (Fig. 1). The North Platte River and two reservoirs formed the eastern boundary, and the area was centrally bisected by the Ferris and Seminoe Mountains. Elevation varied from 2000 to 3077 m. Long term mean maximum and minimum temperatures for June–September are 26.2 and 9.2 C, respectively (Becker and Alyea 1964a). Mean total precipitation for June–September is only 2.3 cm (Becker and Alyea 1964b).

Approximately 80 percent of the study area is federally owned, and administered by the U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, and U.S. Water and Power Resources Service. About 10 percent of the land is state owned, and 10 percent privately owned. Prior to and during this study, the land was managed as

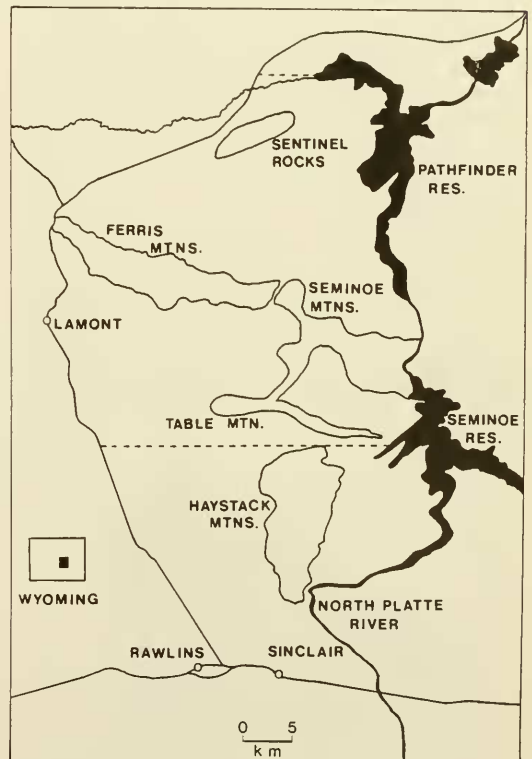


Fig. 1. Study area in central Wyoming, showing the boundaries and major topographic features.

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rangeland, with ranchers specializing in cattle and some sheep.

MATERIAL AND METHODS

Scat Collection and Analysis

Because coyotes do not defecate in a random manner, ground searches for areas of fecal deposition were conducted throughout the study area each month. Areas where coyote scats (feces) were commonly located were fence lines, exposed ridges, dry creek beds, roads, cattle trails, and game trails. Coyote pup scats were also collected at den sites.

The study area was subdivided into six collection sites based on vegetative and geographic difference (Fig. 2). Area I had an abundance of grasses and shrubs seldom taller than 0.3 m and had many creeks and dry washes running between the Ferris and Seminoe Mountains and Pathfinder Reservoir. Area II had similar vegetation, but generally flat topography. Area III had vegetation similar to Areas I and II, but had rolling terrain. Area IV was relatively flat and dominated by sagebrush (*Artemisia* spp.) regularly taller than 0.5 m. This area lay almost entirely within the Great Divide Basin, where precipitation runoff never reaches a drainage connected to an ocean. Area V has vegetation similar to Area III, but had many creeks flowing through it, running between the Seminoe Mountains and Seminoe Reservoir.

Area VI included all mountains, rocky hills and ridges, a pocket of potholes near the center of the study area, and a 2-km strip along a creek that emptied into Pathfinder Reservoir. Vegetation in Area VI was dominated by shrubs taller than 0.5 m, with some above 1.0 m, willow (*Salix* spp.) stands, aspen (*Populus tremuloides*) groves, fir (*Abies* spp.), juniper (*Juniperus* spp.) and pine (*Pinus* spp.).

Each scat was tagged with the date and collection site, placed in a paper bag, and stored for later analysis. Individual scats were securely tied within nylon bags and washed in a low-suds solution in a normal top-loading washing machine. All samples were washed for 4 cycles and broken up by hand between cycles. Washing broke up the fecal matrix, removing all soluble material, and facilitated separation of each scat into various subsamples. Washed scats were tumble-dried at medium heat for an hour until thoroughly dry.

Identification of hair medullas followed the procedure of Moore et al. (1974). Scale casts were made by using the technique described by Johnson (1978). A hair reference collection maintained by the Wyoming Game and Fish Research Laboratory was available for comparison with samples, as were mammal specimens in the University of Wyoming Vertebrate Museum.

Chi-square tests were performed and levels of significance are given where appropriate. An approximate 95 percent confidence interval on a proportion is given by the value:

$$p \pm Z_{.05} \frac{p(1-p)}{\sqrt{n}}$$

where p is the percentage of occurrence,  $Z_{.05}$  denotes the 5 percent "two-tailed" Z value from a standard normal distribution, and n is the number of scats analyzed (Mendenhall 1975, p. 403). Because

$$p(1-p) \leq 0.25,$$

a conservative 95 percent confidence interval (C.I.) is given by

$$\pm 2 \frac{.25}{n}$$

which simplifies to

$$\pm \frac{1}{\sqrt{n}}$$

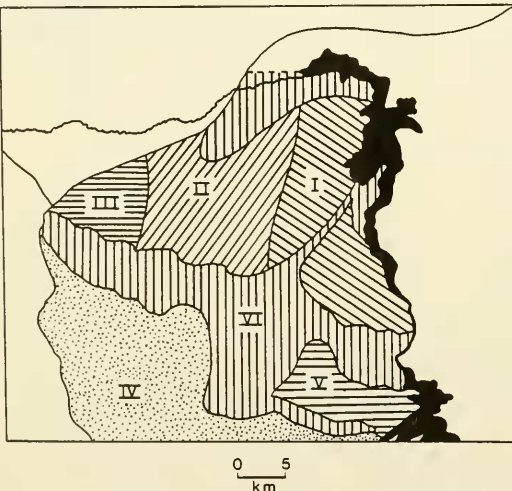


Fig. 2. Six areas within the study area from which coyote scats were collected. Note that Area VI has a northern portion separated from the main part.

## Small Mammal Trapping and Rabbit Census

Small mammal species diversity and abundance were determined by trapping. The large size of the study area required a sampling scheme that could solve problems of economics and logistics. Roadways at least 16 km long that passed through a variety of habitat types were used for trapping transects. At intervals of 1.6 km on alternate sides of the road, a live-trap grid or a snap-trap line was laid out adjacent to the road with a maximum of two live-trap grids/transects. (For example, km 1.6 might have a live-trap grid in sagebrush, km 3.2 a snap-trap line in sagebrush, km 4.8 a snap-trap line in grassland, km 6.4 a snap-trap line in wet meadow, km 8.0 a live-trap in mixed browse, etc.)

The snap-trap lines were composed of 10 stations spaced 10 m apart, with two Museum Special traps or Victor rat traps/stations. The live-trap grids were usually in a seven-by-seven station arrangement, but varied in some instances because of the topography. The stations were spaced 15 m apart with two Sherman live-traps/stations. The live-trap grids were run for four consecutive nights, and the snap-trap lines were run for three consecutive nights. Each morning all traps were checked, reset, and rebaited with a mixture of rolled oats and peanut butter.

Spotlight censuses were used to determine the relative abundance of leporids on the study area. Each month, four census routes were driven. A 200,000 candle-power vehicle-mounted spotlight was used to search approximately 10 m on both sides of the road while driving between 25 and 35 km/hour. Spotlight censuses were started at least 30 minutes after dark and continued for about three hours.

## RESULTS AND DISCUSSION

In total, 404 scats were analyzed and tabulated (Table 1). Results for the whole study area by month are shown in Table 2. Total results from each of the six collection areas (Fig. 2) are shown in Table 3. Area VI (Fig. 2) was considered to be the deer-use area, and results from Area VI were compared to the combined results of all other areas (Table

3). To determine if the soil and vegetational differences between the north and south sides of the mountains had any significant effect on coyote diet, results from the north areas (I, II, III) were compared to the south areas (IV, V), shown in Table 3.

**NATIVE UNGULATES.**— Pronghorn, mule deer, and elk (*Cervus canadensis*) were the three most abundant native ungulates that inhabited the study area, though white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), and bighorn sheep (*Ovis canadensis*) were present in small numbers. No scats were collected from elk summer habitat; thus all occurrences of cervid hair in the scat samples were presumed to be from mule deer.

Considering the entire study area, native ungulates equaled leporids as the most important food group, on the basis of percent

TABLE 1. Analysis of 404 coyote scats collected from the entire study area. Values are percentages of all scats. An approximate 95 percent confidence interval for this table is  $\pm 5$  percent of the values given.

FOOD ITEM	PERCENT	
	Species	Group
Leporids ( <i>Lepus townsendii</i> , <i>Sylvilagus audobonii</i> )		63
Pronghorn Antelope ( <i>Antilocapra americana</i> )	55	
Mule Deer ( <i>Odocoileus hemionus</i> )	5	
Unidentifiable native ungulate	3	
Total native ungulates		63
Sciurids ( <i>Spermophilus richardsonii</i> , <i>S. tridecemlineatus</i> , <i>Eutamias minimus</i> )		21
Microtines ( <i>Microtus spp.</i> , <i>Lagurus curtatus</i> , <i>Phenacomys intermedius</i> , <i>Clethrionomys gapperi</i> )		13
Unidentifiable Cricetidae		7
Cricetines ( <i>Peromyscus maniculatus</i> , <i>Onychomys leucogaster</i> )		3
Western Jumping Mouse ( <i>Zapus princeps</i> )		1
Northern Pocket Gopher ( <i>Thomomys talpoides</i> )	Tr	
Heteromyids ( <i>Dipodomys ordii</i> , <i>Perognathus fasciatus</i> )	Tr	
Total rodents		45
Unidentified plant material		42
Coyote ( <i>Canis latrans</i> )		22
Arthropods (Coleoptera and Orthoptera)		18



occurrence, both with a 63 percent ( $\pm 5$  percent) occurrence. Logically, a single occurrence of an ungulate should represent more calories consumed than a single occurrence of a leporid. Native ungulates had the highest percent occurrence for every month but August (Table 2), though only significantly higher in June ( $P < .05$ ), in the deer (Area VI), and in Area II (Table 3). In specific collection areas, the occurrence of native ungulates varied from a low of 22 percent ( $\pm 16$  percent) in Area III up to 80 percent ( $\pm 10$  percent) in Area VI (deer-use area). Pronghorn was the ungulate most frequently consumed by coyotes as measured by percent occurrence in all months and geographical areas (including the deer-use area). Deer remains were found only in scats collected in the deer-use area (Area VI). On a monthly basis, deer remains were found only in scats collected in June and July, with 14 percent ( $\pm 10$  percent) and 6 percent ( $\pm 16$  percent) respective frequencies of the total for native ungulates for those months.

There are few reports of large ungulates having a high frequency of occurrence as coyote food. Ozoga and Harger (1966) reported a 90 percent occurrence of white-tailed deer in coyote scats collected in northern Michigan in winter. Horn (1941) found a 60 percent occurrence of deer in 7000 scats collected year-round in Santa Barbara County, California. Other studies with comparatively large occurrences of native ungulates include Zadra (1977), with a 45.3 percent occurrence in southeastern Wyoming; McLean (1934), with a 41.7 percent occurrence in California; Ogle (1971), with a 41.6 percent occurrence in Washington; and Hawthorne (1972), with a 35.2 percent occurrence in Sagehen Creek Basin, California.

The high frequency of occurrence of ungulate remains in coyote scats in this study was likely related to availability of ungulate prey. Pronghorn were abundant throughout the study area at lower elevations, and deer occurred in high numbers in the deer-use area. This high availability of native ungulates undoubtedly contributed to the coyote summer diet through direct predation on fawns and perhaps on adults, and by consumption of carrion. It is well documented that coyotes prey on adult and fawn pronghorn (Thompson 1949, Arrington and Edwards 1951, Udy 1953, and Beale and Smith 1973) and deer (Alton 1938, Horn 1941, Cahalane 1947, Robinson 1952, Cook et al. 1971, Hawthorne 1972, and Salwasser 1974). Carrion was available from diseased individuals, road kills, birth complications, and postpartum fawn mortality. Carrion resulting from hunter cripple losses and winter mortality would not have been detected during this study. The frequency data show that coyotes utilized big game as a major food source here. Remains of pronghorn or deer occurred consistently in scats collected in all four months, geographic locations, and collection sites. The extent to which coyotes acted as predators or scavengers could not be deduced from this study.

**LEPORIDS.**— White-tailed jackrabbits (*Lepus townsendii*) and desert cottontails (*Sylvilagus audubonii*) were placed in this broad category because of the difficulty in differentiating leporid hair. These species and native ungulates had the highest frequency of occurrence in scats over the entire study area. Leporids occurred most frequently in scats obtained in August, though they were not significantly higher than the

TABLE 2. Major food groups found in coyote scats collected throughout the summer expressed as percentage of all scats. Does not include 90 scats collected at 2 den sites.

FOOD GROUP	MONTH				
	June (N = 104)	July (N = 137)	August (N = 33)	September (N = 40)	Total <sup>1</sup> (N = 314)
Native ungulate	64	73	61	73	69
Leporid	48	66	76	68	61
Rodent	37	43	45	43	41
Livestock	12	14	6	8	12
Bird	11	10	24	25	14
Approximate 95% C.I. <sup>2</sup>	( $\pm 10\%$ )	( $\pm 9\%$ )	( $\pm 17\%$ )	( $\pm 16\%$ )	( $\pm 6\%$ )

<sup>1</sup>Weighted average.

<sup>2</sup>The C.I. is a percentage of the values given.

frequency of native ungulates ( $P > .05$ ). Leporids were significantly ( $P < .01$ ) the most important food item in the north, south, and Areas I, III, and IV. Leporids predominate as a staple in the coyote diet in studies performed on the plains and arid intermountain areas similar to this study site (Sperry 1933, 1934, 1939, 1941, Murie 1945, Fichter et al. 1955, Fitch and Packard 1955, Tiemeier 1955, Clark 1972, Mathwig 1973).

During the spotlight census, a total of 167 leporids was seen in 361 km driven, for an index of 0.46 animals/km. This number is low compared to similar data collected on this area during previous years. There was no significant correlation ( $r = .27$ ) between the number seen per area and the frequency of occurrence of leporid remains in scats analyzed. The discrepancy between the high frequency in scats and relatively low population index could be due primarily to two factors. The census technique could have biased the numbers seen, and significantly more cottontails and jackrabbits might have been present in rocky and dense vegetation areas that could not be censused. The second possibility is that coyotes on the study area could have been highly selective for leporids in their hunting behavior.

**RODENTS.**—Rodents occur in nearly all food habit studies of coyotes and usually rank in the top three most important food items. They are usually found to be most important in studies performed in mountainous, coastal, and more mesic areas (O. J. Murie 1935, A. Murie 1940, Ferral et al. 1953, Wilson 1967).

In this study all rodents taken as a group were third in frequency of occurrence, appearing in 46 percent ( $\pm 5$  percent) of the scats over the entire study area. Occurrence of rodents in the north (47 percent) was significantly greater ( $P < .05$ ) than occurrence in the south (35 percent).

Some taxa can never be reliable distinguished from each other by hairs or bone fragments, and other taxa can only be distinguished from each other when hairs and skeletal parts occur together in a sample (Johnson 1978). Rodents were placed in the major groups shown in Table 1. For comparison, all rodents were placed into two main groups: mice and rats, and sciurids. Compared to sciurids, mice and rats were more utilized

over the entire area ( $P < .05$ ) and in Areas I ( $P < .05$ ), II, III, and IV ( $P < .01$ ). In every area and collection site, microtines occurred most frequently. Cricetines, geomyids, heteromyids, and zapodids occurred only rarely. Sciurids were more important in Area V ( $P < .01$ ), with 69 percent ( $\pm 14$  percent). This site was adjacent to a prairie dog town, however, in which 67 percent of the 69 percent was found to be *Cynomys*.

In our attempt to determine which species of rodents were available to coyotes, we found deer mice were the only species that appeared consistently in all habitats, months, trapping grids, and trapping transects. Yet deer mice occurred in less than 3 percent of the scats analyzed. Microtines, which occurred most frequently (13 percent), never appeared in the trapping grids or trapping transects. Sciurids, which were important food items, were rarely trapped.

Habitat affinities for cricetids, heteromyids, and sciurids were determined by Maxwell (1967) in eastern Wyoming. The same basic habitats were sampled in this study area, yet fewer species were caught. By using both live-traps and snap-traps, bias in the form of a proneness for a species to approach or avoid a trap should have been removed. There are several factors that probably affected trapping success. The size of the study area precluded intensive trapping efforts in each habitat. This reduced the chances of capturing the rare or elusive species. With such a large study area, logistics and economics played a larger role in planning and implementing the trapping scheme. Some of the species that presumably inhabited the study area (Long 1965) occurred in higher elevations (which were not sampled) or in very limited riparian habitat. Runways for trap placement to increase the trapping success of certain sciurids and microtines were not actively sought. Also, rodent numbers (except *Peromyscus*) could have been low, and the occurrence of voles and squirrels in scats might have been due to selective feeding by coyotes. Another factor could be that *Peromyscus* do not use runways and are more nocturnal, which would make them more difficult for coyotes to catch. Laying down a grid and checking it for several consecutive days could alter the trapability of certain

rodents (Manville 1949, Kikkowa 1964, and Sheppe 1967). Finally, trapping as a method of determining population characteristics may not be completely valid. The determination of home ranges by trapping methods has been criticized by Hayne (1950); it reveals the complex relationship between an animal and a set of traps rather than a biological characteristic of the animal's normal life history.

**LIVESTOCK.**— Livestock were grazed on more than 90 percent of the study area but only occurred in 14 percent ( $\pm 5$  percent) of all scats analyzed. Cattle accounted for 8 percent ( $\pm 5$  percent) and sheep 6 percent ( $\pm 5$  percent) of the livestock occurrences. Compared to sheep, cattle occurred more frequently in all months in Areas I, II, III, and IV, though sheep occurred more frequently than cattle in Area IV.

Sperry (1941) felt that most body parts of livestock found in coyote diet samples were from carrion. This also has been suggested by others (Fichter et al. 1955, Gier 1968, Clark 1972, and Meinzer et al. 1975). Klebenow and McAdoo (1976), however, found the coyote to be a major predator on sheep in northeast Nevada, as did Dorrance and Roy (1976) in Alberta. A few cases of clear coyote predation were observed, and predation on sheep was reported to be a problem by one ranch on the study area. Animals that were found dead of other causes were not observed to be fed upon during the course of the coyote food habits study.

**BIRDS.**— All birds are lumped into one group because only shafts of feathers were

recovered, and no positive identification could be made. Bird remains were found in 11 percent ( $\pm 5$  percent) of the scats collected over the entire study area. Occurrences of birds were highest in September (25 percent  $\pm 16$  percent), and in Area I (27 percent  $\pm 15$  percent). Sage grouse (*Centrocercus urophasianus*) were available throughout the study area and may have been the main contribution to the bird remains.

**ARTHROPODS.**— Beetles (*Coleoptera*) and grasshoppers (*Orthoptera*) were found in 18 percent ( $\pm 5$  percent) of the scats but mostly in trace amounts. Only two scats were found to be made up almost exclusively of grasshoppers.

**VEGETATION.**— Plant fragments were found in 45 percent ( $\pm 5$  percent) of all scats. Almost all samples contained only a trace of vegetation. It is felt that most vegetation in scats resulted from incidental consumption during normal feeding and the adherence of leaves and twigs to feces after defecation.

**REPTILES.**— Unidentified snake remains were found in four scats.

**COYOTE.**— Some coyote was found in 20 percent ( $\pm 5$  percent) of all scats. Most of one scat was composed of coyote hair, indicating a possible instance of cannibalism. Trace occurrences in other scats were probably due to grooming by the coyotes.

CONCLUSIONS

This study was done to help determine if coyote predation was a significant depressant

TABLE 3. Major food groups in coyote scats collected in different areas (Fig. 2) throughout the summer, expressed as percentage of all scats containing the group specified.

FOOD GROUP	AREA									
	I (N = 45)	II (N = 86)	III (N = 37)	IV (N = 101)	V (N = 54)	VI <sup>1</sup> (N = 81)	Non- deer <sup>2</sup> (N = 323)	North <sup>3</sup> (N = 177)	South <sup>4</sup> (N = 146)	Total <sup>5</sup> (N = 404)
Native ungulate	62	78	22	52	63	80	59	62	56	63
Leporid	78	72	70	62	63	42	68	69	67	63
Rodent	42	42	27	31	69	63	41	47	35	45
Livestock	4	8	35	13	0	17	11	12	10	12
Bird	27	15	3	8	6	12	12	10	14	11
Approximate 95% C.I. <sup>6</sup>	$\pm 15\%$	$\pm 11\%$	$\pm 16\%$	$\pm 10\%$	$\pm 14\%$	$\pm 11\%$	$\pm 6\%$	$\pm 8\%$	$\pm 8\%$	$\pm 5\%$

<sup>1</sup>Area VI was the only high deer-use area.  
<sup>2</sup>Non-deer areas were Areas I, II, III, IV, and V.  
<sup>3</sup>North was Areas I, II, and III; scats from dens not included.  
<sup>4</sup>South was Areas IV and V; scats from dens not included.  
<sup>5</sup>Weighted average for the entire study area.  
<sup>6</sup>The C.I. is a percentage of the values given, not a percentage of N.



to mule deer populations. Coyotes on this study area consumed mule deer, either through predation or as carrion, as shown by scat analysis. Pronghorn occurred more frequently in scats because of their wider distribution. There was a conflict in this study area between man (his interest in ungulates as game and livestock) and coyotes (their interest in ungulates as food). Food habits studies cannot resolve this conflict. More information is needed: population sizes of coyotes and potential prey, hunting pressure by man, predation rates, productivity rates of coyotes and prey species, availability of carrion, effects of predator control, and other important parameters. Several of these areas were investigated and reported by Springer and Wenger (1981). Food habits studies can, however, indicate to wildlife managers that a potential problem exists. The fact that native ungulates occurred so frequently in the coyotes' diet certainly indicates that a problem could develop if coyote numbers become higher.

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